Control system development for Coline 6 linear accelerator

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Purpose/Objective: The purpose of this study was to verify safety interlocks consistent with international standards IEC 60601-2-1 using a linear accelerator Coline 6 control system developed through the European Accelerators & Detectors AiD Project (AiD project: Development of dedicated systems based on accelerators and detectors of ionizing radiation for medical therapy and indetection of hazardous materials and toxic wastes) in The Polish National Centre for Nuclear Research.
Materials and Methods: The pre-prototype of the control system works with the registration and verification software developed in the National Centre for Nuclear Research and Treatment Planning System PHJ Prague.The system analysis was performed to assess the security operation responsible for the dose off including verifications of error messages of measurement doses related to dosimetry measurement devices, mechanical failure of accelerator elements and use by an unauthorized user. Before starting the irradiations various cases ofoperator errors, omissions in remote data retrieval therapy and manual dialing parameters were tested. During the irradiations different schedules of dose measurements device and accelerator mechanical device errors were tested.
Results: Safety of the patient during the irradiation is dependent on the manufacturer of the treatment devices. The accelerator control system was designed to meet all treatment parameters obtained from the Treatment Planning System and terminated irradiation if the parameters were inconsistent with the plan. The pre-prototype of the control system met all requirements.
Conclusions: The analysis of the cases used in this study showed that the control system created as a pre-prototype can be the first step to create clinically acceptable software.

ELECTRONIC POSTER: BRACHYTHERAPY TRACK: GYNAECOLOGY

EP-1334

Undetected uterine perforation in cervical cancer Brachytherapy may result in harmful over dose of OARs

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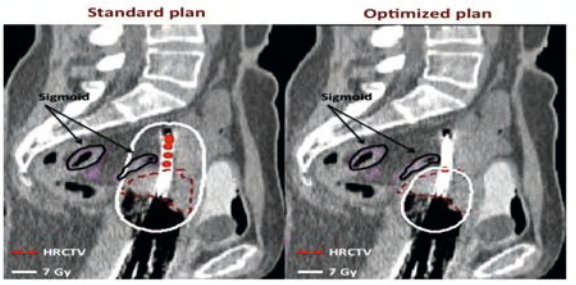
Purpose/Objective: The importance in local control and toxicity of optimal applicator placement in cervical cancer brachytherapy (BT) is well established. Nevertheless uterine perforation remains a frequent complication, generally undetected by classic QA measures of 2D BT to assess the adequacy of implant placement. 3D BT based on CT imaging allows optimal visualization of applicator's position in respect to the OARs thus enabling the possibility of dose optimization. Aim of this work is to define the dosimetric impact on OARs of undetected uterine perforation when a standard point A optimized dose distribution is applied and the eventual dosimetric gain achievable with 3D CT-based dose optimization.
Materials and Methods: 23 CT-based tandem/ovoids BT applications complicated by uterine perforation were selected. All patients had a FIGO IIB cervical cancer and were planned to receive radio-chemotherapy (1.8 Gy per fraction up to 45 Gy with concomitant weekly cisplatin) and BT (4 fractions of 7 Gy) with a plan optimized to HRCTV drawn according clinical findings at the time of BT. The planning aim for dose optimization was to keep the D2cc value for rectum, bladder and sigmoid below 4.6 Gy, 6.5 Gy and 4.6 Gy respectively. Moreover a standard point A plan was calculated and respective DVH parameters for HRCTVs and OARs compared. Wilcoxon test was applied for statistical data analysis and calculated with Matlab 7.11 software (Mathworks Inc).
Results: Median HRCTV width was 46 mm (37-64 range). Median HRCTV D90 and OAR D2cc values achieved with standard or the optimized plan are listed in table 1. When the standard plan was applied the intended dosimetric constraint for rectum, bladder and sigmoid were not achieved in 15 (60%), 10 (43,5%) and 19 (82%) applications respectively while they were always met in the 3D optimized plans. In 8 out of the 19 standard plans where the dosimetric constraint was exceeded the sigmoid D2cc was higher than 8Gy. In 3 cases out of 19 it was higher than10Gy.

*p-value < 0,001	Standard plan	Optimized plan
HRCTV D90 (Gy) *	7,5 (range 6 - 10,1)	6,4 (range 4,8 - 9,6)
Rectum D2cc (Gy) *	5,2 (range 2,33 - 6,73)	4,5 (range 2,68 - 4,71)
Bladder D2cc (Gy)	6,3 (range 3,8 - 17,6)	6,1 (range 4,34 - 6,4)
Sigmoid D2cc (Gy)*	6,8 (range 1,78 - 16,75)	2,9 (range 0,8 - 4,65)



Conclusions: The occurrence of uterine perforation should be kept as low as possible by the routine use of US during GYN BT implantation. When uterine perforation occurs it is easily detected on CT images but rarely on the orthogonal films. In case of uterine perforation 2D planning may thus results in potentially dangerous over dosage of OARs. 3D optimization allows keeping OAR dose within tolerance constraints just minimally compromising HRCTV D90 coverage.

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Clinical experience with hyaluronic acid to prevent radiation cystitis in gynecological cancer: literature review

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Purpose/Objective: To evaluate if glycosaminoglycan's (GAG) administration as hyaluronicacid (HA) intravesical instillations reduces the rate of acute and lateradio induced bladder toxicity as a complication of radiation treatment in gynecological cancer. A review of the literature was done to analyse which treatments were used in this field and the HA role among them.
Materials and Methods: Retrospective study of 70 patients diagnosed with cervical and endometrial cancer treated between May 2010 and June 2012 with high-dose rate brachytherapy (HDR-BT) with or without external beam radiotherapy (EBRT). 50/70 received an EBRT total dose of 45-50.4 Gy delivered in 25-28 fractions followed by brachytherapy (HDR-BT) 11Gy in 2 fractions. The remaining 20 patients received HDR-BT alone, 21 Gy in 3 fractions. All of them received intravesical instillations of hyaluronic acid (HA) immediately after each HDR-BT fraction according to recommendations of medical prospectus. 5/50 (10%) presented G1-2 toxicity before brachytherapy. RTOG/EORTC scale was used to evaluate acute and late toxicity rates at 3, 6, 12 and 18 months after HDR-BT. A review of the literature was made using Medline research with the following criteria: HA prevention and gynecological cancer and radioinduced cystitis.
Results: Regarding our study, no upgrading toxicity was observed in patients treated with combined HDR-BT and EBRT (50/70) during the follow-up period. None of the patients (20/70) treated with exclusive HDR-BT had bladder toxicity neither acute nor chronic. No adverse events related to HA were observed. After reviewing literature, we observed that HA instillations have demonstrated effectiveness in relieving symptoms associated with interstitial cystitis, considering a similar biological pattern to radioinduced cystitis. 2 studies with these characteristics and written by the same authors were found: P. Samper et al. The first one is an abstract presented at ASCO 2003 with 90 patients and the other a retrospective study with 95 patients; both of them demonstrate that HA instillations are effective in radioinduced cystitis prevention.
Conclusions: Intravesical instillations of hyaluronic acid are effective in preventing radiation cystitis. It is safe and well tolerated. Given the scarcity reports on this subject, it is difficult to draw any firm conclusions about standard recommendations. However, based on our experience, intravesical HA can be used as routine before each brachytherapy fraction in gynecological cancer. A prospective randomized control study with a large number of patients and long term follow-up is recommended.

EP-1336

Vaginal brachytherapy for endometrial cancer: pulsed dose rate versus low dose rate, a single institution analysis.